Sequential assessment of spinal cord location in Adolescent Idiopathic Scoliosis

Grant C.A., Newell N., Izatt M.T., Keenan B.E., Little J.P., Askin G.N., Labrom R.D., Adam C.J., Pearcy M.J.

Paediatric Spine Research Group, Queensland University of Technology and Mater Health Services, Brisbane, Queensland, Australia.

Introduction: While the incidence of lasting neurological damage in AIS posterior surgical correction is low (below 1%[1]), the location of the spinal cord within the spinal canal is still of concern. The incidence of medial encroachment of pedicle screws into the canal is reported as being 3.7%[2], though several authors report so called "safe zones" of screw protrusion up to 4mm[3]. Given the current popularity of concave pedicle screws we investigated the location of the spinal cord in the canal in AIS.

Aim: To determine the proximity of the spinal cord to the concave pedicles, and its relationship to curve severity and growth.

Materials and Methods: Three sequential MRI scans (intervals of 6-12 months) of AIS patients were obtained. Using a locally aligned transverse plane at the mid height of the pedicles, the location of the spinal cord within the canal was assessed for all vertebra included in the scan (typically T4-T12). The cord position was denoted as being in contact with the pedicle or not.

Results: At the first scan (n=25), participants were mean 12.7 years with a mean Cobb angle of 31.6°. For Scan 2 (n=17), mean age 13.3 years and Cobb angle 36.0°; Scan 3 (n=11), mean age 14.3 years and Cobb angle 46.0°.

84% of patients at Scan 1 had contact between the spinal cord and the concave pedicle at the apex of their curve, with 80% in contact one level cranial to the apex, and 72% at one level caudal. By Scan 2 however this increased to 88% one level superior and inferior to the apex, and contact was observed in over 70% of cases at 2 levels above and below the apex. At Scan 3 100% of cases had contact between the spinal cord and the concave pedicle at the apex and the level superior to the apex, and over 70% maintained cord-pedicle contact out to the apex ± 2 levels.

Conclusion: With the spinal cord taking the shortest route through the canal, the reported existence of "safe zones" for pedicle screw encroachment into the canal may not apply in the apical region of the scoliotic deformity. The cord was found to be in contact with the apical concave pedicle 100% of the time for curves approaching operable size. It should also be noted that the Cobb angles of the curves analysed were mostly smaller than would be typical at surgical intervention. This study found that with increasing Cobb angle there was a corresponding increase in the incidence of contact between the spinal cord and the concave pedicle in the apical region of the deformity.

References:

1. 2011 Hamilton DK, Smith JS, Sansur CA, et al. Rates of new neurological deficit associated with spine surgery based on 108,419 procedures: a report of the Scoliosis Research Society morbidity and mortality committee. Spine 36:1218-28
2. 2010 Hicks JM, Singla A, Shen FH, et al. Complications of pedicle screw fixation in scoliosis surgery: a systematic review. Spine 35:E465–70
3. 2004 Kim YJ,Lenke LG, Bridwell KH, et al. Free hand pedicle screw placement in the thoracic spine: is it safe? Spine 29:333–42